FREQUENCY OF NORTHERN GOSHAWK PRESENCE IN THE NORTHERN REGION 2005 SURVEY

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INTRODUCTION

The Northern Goshawk (*Accipiter gentilis*) is designated as a Sensitive Species in a number of Forest Service Regions. It is also identified as a Management Indicator Species (MIS) on many National Forests. In the Northern Region, it is classified as "Sensitive" Region-wide and is an "MIS" on all but the Bitterroot and Kootenai National Forests and the Dakota Prairie National Grasslands. All National Forests in the Region have been monitoring goshawks and goshawk habitat to some degree during recent years.

In the spring and summer of 2005, the Northern Region conducted a field survey of goshawks across the accessible portions of the Region. The primary purpose of this survey was to use a statistically based approach to (1) estimate the rate of goshawk occupancy (frequency of goshawk presence) within a grid that approximates the territory size for this species and (2) better define and document the geographic distribution of goshawks across the Northern Region. The reasons for placing high priority on conducting the survey included: (1) the desire to improve baseline information on the species; (2) the desire to reassess the goshawk's status as Sensitive within the Region and (3) the need to obtain more data on goshawks and goshawk habitat in order to better describe suitable goshawk habitat and better respond to issues raised in appeals and litigation. Additionally, data from the survey would be used to (1) supplement previously collected field data from National Forest System lands and (2) complement a Region-wide Conservation Assessment of the Northern Goshawk that was concurrently being developed (Samson, 2005).

The Northern Region conducted the survey of goshawk presence using the recently developed "Northern Goshawk Bioregional Monitoring Design" (Woodbridge and Hargis 2006, Hargis and Woodbridge 2006). This grid-based protocol is currently being published and assesses goshawk population and habitat information across distinct bioregions. The Northern Region encompasses a majority of the Northern Rocky Mountains/Blue Mountains Bioregion (Figure 1) as delineated by Woodbridge and Hargis (2006). Although Hargis and Woodbridge (2006) listed 3 objectives in their proposed long-term study plan, only the

first of those, estimation of the "frequency of goshawk presence" within a Bioregion, can be addressed in a single-year survey such as this one. "Frequency of goshawk presence" is defined as the proportion of all of the potential sampling units approximating the size of a goshawk breeding territory in the chosen sampling frame that are estimated to have been occupied by goshawks.

Northern Region National Forests have been locating and monitoring nests and evaluating nest success for many years. The initiation of this specific Region-wide field survey was intended to augment and strengthen the statistical reliability of existing Forest information. This report presents the results of our attempt to estimate the frequency of goshawk presence and distribution in the accessible (essentially non-Wilderness and non-Roadless) portion of National Forest System lands within the Northern Region.

METHODS

SAMPLING SCHEME

The Northern Goshawk Bioregional Monitoring Design (Woodbridge and Hargis 2006) calls for establishing a stratified random sample of the entire Bioregion, where the stratification is based on habitat quality and ease of access. The four resulting strata are: high quality habitat with easy access, high quality habitat with difficult access, low quality habitat with easy access, and low quality habitat with difficult access. The purpose of such stratification is to maximize the efficiency of sampling by weighting the sampling effort (1) in favor of areas having greater likelihood of supporting goshawks and (2) against samples requiring a high degree of survey effort.

The Northern Region did not implement a stratified random sample design. Instead, we acquired a simple random sample from all potential 1700 acre sampling units (PSUs defined below) within the Region that contained National Forest System lands, excluding only those sampling units that lacked road access (based on our Regional Roads database) somewhere within the PSU. In addition, we confined our survey to that portion of the Northern Rocky Mountains/Blue Mountains Bioregion lying within R1, ignoring eastern Oregon, eastern Washington, central Idaho, and the Wyoming Rockies, as well as non-FS lands within the boundaries of the Bioregion.

We took this approach for practical and financial reasons. We did not differentiate between high and low quality habitat because we were not confident that our broad-scale Regional vegetation data set had sufficient spatial resolution to make a clear distinction between high and low habitat quality. We excluded areas that lacked road access, at least somewhere in the 1700 acre sampling unit, because we lacked sufficient funds to conduct a complete survey of all NFS lands across the entire Region.

By not stratifying by habitat quality, to some extent we actually took a more conservative approach to estimating goshawk occupancy. This is because we included sample PSUs irrespective of habitat condition and, therefore, included PSUs across the entire habitat quality spectrum. As a result, our sample included many PSUs that included very poor quality or unsuitable habitat, such as low tree density or even non-forested environments.

By limiting our sampling to PSUs that had road access somewhere within the 1700 acre sampling unit, we were unable to draw statistical inferences regarding goshawk occupancy in those PSUs that totally lacked roads, such as the interior portions of Wilderness and Roadless areas. However, with limited funding to conduct these surveys and by restricting our surveys to areas with at least minimal access, we were able to make much more efficient use of survey personnel. Despite this limitation, we included in our sampling frame 12,350 out of a total of approximately 17,750 of the PSUs in the Idaho and Montana portions of the Northern Region.

Although we did not include PSUs that were totally lacking roads, some unroaded habitats were actually included in our sampling effort. This occurred because the PSUs were of a relatively large size (1700 acres) and normally contained some amount of remote habitat. As a result, many sampling points in sparsely roaded PSUs fell well away from roads. In some cases, sampling points occurred well within classified Wilderness Areas, Roadless Ares and other remote environments.

The pre-publication version of the goshawk protocol called for delineating Primary Sampling Units (PSU) that were 1700 acre squares. This PSU size was selected to correspond with the nearest-neighbor distances between goshawk nesting areas determined from a review of published goshawk studies. PSU size was subsequently changed to 1482 acres after our monitoring program was completed (Hargis and Woodbridge 2006.). We deviated slightly and employed a PSU that was slightly larger (1722 acres) than originally

recommended (Figure 2), in order to accommodate differences in pixel size between the remotely sensed vegetation imagery available for the eastern and western portions of the Region. Bill Kirchhoff (GIS specialist, RO Engineering) created a GIS layer that covered all of R1 with a grid of 17,750 PSUs of that size. Our sampling frame consisted of only those PSUs (about 12,350 PSUs, or 69.6% of the total) that contained any National Forest System lands and, based on our R1 roads database, were accessible by a road anywhere within the PSU. From those PSUs, we randomly selected 200 to be surveyed for goshawk presence.

Although we were uncertain how many PSUs we could survey in the available time, we felt confident that we could easily survey 200 PSUs in the time allotted. Therefore, we based our data collection plans on completing at least 200 PSUs during the sampling period. In practice, surveying 200 PSUs proved to be overly optimistic and we were actually able to survey only 114 PSUs. Although this number proved to be an adequate sample, it created some data analysis complications that are discussed later.

SURVEY PROCEDURES

The survey protocol uses the acoustical broadcast calling technique developed by Kennedy and Stahlecker (1993). Each PSU was covered by 130 systematically spaced calling points, spaced so that any point within the PSU was within 150 m of a calling point (Figure 2). Surveyors visited each calling point located on NFS land, unless the point was on a slope greater than 60%, in deep water, or surrounded by unsuitable habitat. Unsuitable habitat was defined as non-forested areas. To the extent possible, surveyors started with calling points located in the highest quality habitat or in the vicinity of known active nests in order to obtain a detection as early as possible. When a goshawk was detected, the surveyors terminated their survey of that PSU and spent no more than 2 hours searching for a nest in the vicinity of the detection. If no nest was found, the surveyors notified their supervisor and left any further nest-searching to Forest or District personnel.

At each calling point, the surveyors, using Fox Pro FP48 electronic broadcast callers, broadcast the goshawk alarm call, either alone (from 12 May until 27 June) or in combination with the juvenile food-begging call (from 28 June until 31 July). Calls were broadcast 6 times at each visit to a point, with a 30-second listening period between each 10-second calling period. The surveyors rotated their direction of calling by 60 degrees between each calling period. Broadcast calls were intended to elicit a response from any

goshawks within auditory range of the call. A vocal response, a silent approach or flyover, the discovery of an active nest, or the observation of freshly molted feathers was considered to be a goshawk detection.

In accordance with the goshawk protocol, each PSU was visited twice during the survey. The first visits were conducted from 12 May to 27 June, and the second visits were conducted from 28 June to 31 July. Two visits were required in order to estimate goshawk detectability, a parameter required to calculate the maximum likelihood estimate for the goshawk presence rate. Possible outcomes of the survey include: detections on both visits to a PSU; detections on neither visit to a PSU; detection on the first visit to a PSU but not on the second visit; or detection on the second visit to a PSU but not on the first. In addition to the above situations, the statistical software used to calculate goshawk presence could also accommodate the case where a PSU was visited only once but had a detection occur during that single visit.

PERSONNEL

Skip Kowalski served as the Bioregional Coordinator, Bill Kirchhoff prepared the GIS products and a contractor, John Malloy, served as the field coordinator. The R1 Forests that participated in the goshawk survey were aggregated into 4 zones, each coordinated by a zone coordinator. The 4 zone coordinators were Tom Whitford (Custer, Lewis & Clark, and Gallatin National Forests), Lorraine Brewer (Beaverhead/Deer Lodge, Helena, and Bitterroot National Forests), Al Bratkovich (Kootenai, Flathead, and Lolo National Forests), and Dan Davis (Clearwater, Nez Perce, and Idaho Panhandle National Forests).

We employed 23 people to conduct the field visits to the PSUs. The Avian Science Center at The University of Montana assisted greatly in the recruitment and evaluation of candidates for the survey crews. Selected candidates were extremely well qualified in bird identification and ornithological skills, particularly as they related to goshawks. Candidates were screened for these skills prior to hiring and skill capabilities were strengthened through specific training and opportunities for feedback throughout the field season.

The arrangements under which the surveyors were employed varied. Seven of the Forests hired 2-person crews as seasonal employees. The 3 Idaho Forests contracted with the Idaho Department of Fish and Game (IDF&G) who hired six employees, exclusively for the goshawk work. The contract with IDF&G also provided for the services of Joel Sauder (IDF&G non-game biologist), who directly supervised all of the

people conducting goshawk surveys on the Idaho Forests. The Flathead National Forest used 2 permanent employees to conduct the field visits on that Forest, while the Gallatin National Forest contracted with a single contractor to visit their PSUs. At least 6 additional people participated in conducting the surveys (2 from the Custer National Forest, 2 from the Helena National Forest, and 2 from IDF&G).

DATA ANALYSIS AND DATA STEWARDSHIP

Jim Baldwin, Research Statistician for the Forest Service Pacific Southwest Research Station (PSWRS) and the statistician for the Northern Goshawk Inventory and Monitoring Design Team, developed an Excel macro that calculates a maximum likelihood estimate of the Bioregional goshawk presence rate with its associated 95% confidence limits, using detection data that were collected in accordance with the goshawk protocol. We used that program to calculate the estimates of goshawk presence presented in this report.

The data collected during the 2005 goshawk survey in R1 are currently archived in an Access database available at K:\wwfrp\2600\2670-tes\goshawk\Goshawk Survey 2005\Survey Effort\. The Excel macro is also archived in that folder. When a migration template becomes available for use with data collected from all Regions, the R1 data will be migrated to NRIS Fauna, the Forest Service national repository for wildlife observation and survey data. PSUs sampled during the survey, and their associated results, are mapped and are available for display on http://fsweb.r1.fs.fed.us/wildlife/wildlife/index.htm

RESULTS AND DISCUSSION

ESTIMATE OF GOSHAWK FREQUENCY OF OCCURRENCE IN REGION 1

The maximum likelihood estimate of the proportion of PSUs with goshawks present in road-accessible lands in Region 1 is 0.39, with a 95% confidence interval of 0.29 to 0.50. This is based on visits to 114 PSUs that were distributed across 12 National Forests in the Region, resulting in 40 PSUs with goshawk detections on one or both visits. In addition to obtaining 40 detections out of the 114 PSUs sampled, crews located seven new goshawk nests.

This one-year estimate suggests that during the nesting period goshawks were fairly common and widely distributed in the roaded (or more managed) portions of NFS lands in Region 1. Because of the difficulty in determining if a goshawk territory (or PSU in this case) is occupied without a doubt (or unoccupied without a doubt) (Reich et. al. 2004), goshawk presence in Region 1 may actually be under-estimated. This would be the case if, for our sample, we failed to detect goshawks in PSUs where they actually occurred. Reynolds et al. (2005 at p. 13) stated that it may take up to 10 person days of annual nest searches for up to 8 years to "estimate the presence of goshawks on territories."

Although the surveys were biased to the roaded portions of the Region, results are consistent with Clough (2000) who through a randomized survey design in west central Montana, found goshawk nests well distributed in the roaded and more intensively managed portion of her study area within 1 to 5 km from the grassland/forest interface, whereas nesting goshawks were not detected in the unroaded or less disturbed habitats found at higher elevations. Results are also consistent with McGrath et al. (2003, n=97) who found goshawks in the northwestern United States select areas near human activities (or areas associated with roads).

We also evaluated whether this estimate could be somewhat inflated because of the sequential order in which some PSUs were surveyed. Although the original sample of 200 PSUs was randomly selected from the pool of 12,350 road-accessibble PSUs, the sequential order of units surveyed on some of the Forests was not random. In some cases, PSUs perceived as having a higher potential for goshawk presence were surveyed first, leaving PSUs perceived as less productive to be surveyed last. Similarly, readily accessible, low elevation and snow-free PSUs were sometimes surveyed first, leaving higher elevation and/or snow covered PSUs to be surveyed last. As a result, as survey time ran out, it became apparent that some less productive and/or higher elevation PSUs might not be surveyed. This potential source of bias was discovered after 80 PSUs had been surveyed and partially successful efforts were made to ensure that the remaining PSUs were surveyed in a completely random order.

To evaluate this potential source of bias, we separated the PSU sample into two subsamples, "non-random PSUs" (n=80) and "random PSUs" (n = 34), and generated an independent maximum likelihood estimate of goshawk frequency of occurrence for each. For the non-random subsample, the estimated frequency of goshawk presence was 0.40, with a 95% confidence interval of 0.27 to 0.54. For the random subsample, the estimated frequency was 0.33, with a 95% confidence interval of 0.17 to 0.50.

Since the confidence intervals for both estimates broadly overlap, we combined both subsamples into one data set (J. Baldwin, pers. comm.). The estimate of 0.39 thus represents an outcome for all 114 PSUs that were sampled. If, however, we chose to accept only the estimate from the PSUs surveyed in random order, the estimate of 0.33 still represents a notable rate of goshawk presence throughout the road-accessible areas of Region 1.

If we use the above confidence limits to extrapolate to the entire set of PSUs within the accessible portion of the Northern region, we obtain a maximum likelihood estimate of 4,816 PSUs with goshawk presence and, based on a 95% confidence interval, having a range of 3,581 to 6,175 PSUs with goshawks present. Should we desire to take a more conservative approach in making our estimates, we could use the estimate based on the smaller (n=34) sample of "random" PSUs. Using this approach, we still obtain a rather large number of PSUs (4,075 with a range of 2,099 to 6,175 at the 95% confidence level) estimated to have goshawks present in the accessible portion of the Region.

Although it would be desirable to provide an estimate of goshawk presence for all PSUs within the Region, extrapolating these data to all NFS lands within the R-1 portion of Idaho and Montana is inappropriate. Not only would this estimate make inferences for areas outside of those actually sampled, it also extrapolates to areas having a relatively high proportion of lower quality habitat. This situation exists because much of the unroaded and classified Wilderness portions of the Region are at high elevation and/or consist of poorly or non-forested environments.

GEOGRAPHIC DISTRIBUTION OF GOSHAWKS

A review of a map of the sampled PSUs (Figure 3) shows that goshawks are well distributed across the Region. Red squares show sampling locations for PSUs where goshawks were not detected, while yellow circles show locations of PSUs where goshawks were detected either once or twice during the sampling period. With the exception of the Bitterroot and Clearwater National Forests, every Forest in the Region had a least one detection during the 2005 survey.

Clearly, goshawks are distributed from the Idaho Panhandle and Nez Perce National Forests in the western part of the Region to the Custer and Lewis and Clark National Forests in central Montana. Although there

were no goshawk detections on the Bitterroot and the easternmost Districts of the Custer, those Forests do indeed have nesting goshawks. In the case of these Forests, the lack of detections was not attributable to a lack of goshawks, but was merely a result of random sampling. Recent, but independent, surveys for goshawks have documented goshawk presence on all Forests in the Region. To place this situation in context, Figure 4 supplements information from the 2005 survey with known goshawk nest locations that have been active, at least one year, during the previous five years.

In his conservation assessment of northern goshawks in Region 1, Samson (2005) demonstrated that well-distributed and abundant habitat exists for the species on today's landscapes. There have been substantial increases in the extent and connectivity of forested habitat since European settlement; the level of timber harvest of the forested landscape in the Northern Region has been insignificant (i.e. < 0.0009% in 2004); and suppression of natural ecological processes has increased and continues to increase amounts of northern goshawk habitat (*Id*. at 38-39).

CONCLUSIONS

This survey has made great progress in achieving the purposes identified for the project. We used the most recent protocol to estimate the frequency of goshawk presence in the Region. We supplemented goshawk information that had already existed on the various Forests with Region-wide data that were collected in a statistically reliable manner. We verified that goshawks are widely distributed across the Region and we have established a baseline for documenting goshawk presence. Depending on funding and priorities, we can either strengthen this baseline by collecting additional data in future years or we can consider this information as a reference condition to which we can compare future surveys. These data should also be useful, when used with other appropriate information, in evaluating the status of the goshawk as "Sensitive" in the Region. These data will most certainly be of value in preparing environmental analyses and should contribute to making more well-informed decisions regarding goshawk habitat.

Based on the results of this survey, the frequency of goshawk presence in the accessible portion of R1 suggests that the goshawk is a relatively common and well-distributed avian predator in the Northern Region. This conclusion is based not only on the number of detections made (40) out of 114 PSUs sampled, but also on the distribution of these detections supplemented with Forest goshawk nest information that has been accumulated over the past five years. To conclude that goshawks are not exceedingly rare is further

supported by the fact that we found seven new goshawk nests within the PSUs associated with the 40 documented detections. Since goshawk nests can be very difficult to locate and since crews searched for nests for only a very short time (normally less than two hours), the 0.175 new nests per detection suggests that some reproduction is occurring.

Since this was the first attempt by a Region to use this national protocol to estimate goshawk presence on a large spatial scale, there are no other bases for comparison. As a result, it is difficult to draw conclusions relative to the overall population status of goshawks in the Region. However, since goshawk researchers have found no evidence that goshawks are declining in the western United States (Kennedy 1997, Squires and Kennedy 2006) and Samson (2005) demonstrated that goshawk habitat was well-distributed and abundant in R1, our estimate of goshawk presence suggests that goshawks are abundant and well-distributed throughout the accessible portions of R1 National Forest System lands within Montana and Idaho during the breeding season. It must be kept in mind, however, that this conclusion is based on a one-year investigation and future surveys will probably be needed to confirm whether this pattern continues to hold true. The extent and frequency of future surveys will depend on available funding and how the data needs for goshawks compare with the needs for other high priority species.

ACKNOWLEDGEMENTS

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A project of this geographical scale requires numerous field workers to collect the actual data, and it's customary to state that "we couldn't have done it without them." But, we didn't do it; they did it. Here are their names, listed in approximately geographical order from the northwestern corner of R1 to the southeastern corner: David Tidhar, Gabe Jenkins, Andrew McGann, Yoav Bar-Ness, Melissa Merrick, Ben

McMahan, Heather Huggins, Brian Dorsey, Jessica Shotzberger, Rob Spence, Henry Rivera, Mike Lucas, John Csoka, Leigh Greenwood, Gary Cargile, Devon Thrasher, Colleen Bitter, Terri Thompson, Jenny Richards, Tam Hekrdle, Kate Shick, Nathan Stone, Randy Wold, Trevor Buffington, Damon Haifley, Maggie Edwards, David Roth, Barb Pitman, Tawni Parks, Jeremy Zimmer, Sam McColley, Dave Kimble, Craig Olwert, Jennifer Stenglein, Becky Summerer, Sarah Wallace, Siri Framness, Matthew Tyers, Karen Kimble, Leah Spurlin, Matthew Scafford, and Kurt Prond.

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Figure 1. Northern Goshawk bioregions in the United States. This Figure was prepared by Hargis and Woodbridge (in prep.) and used with permission.

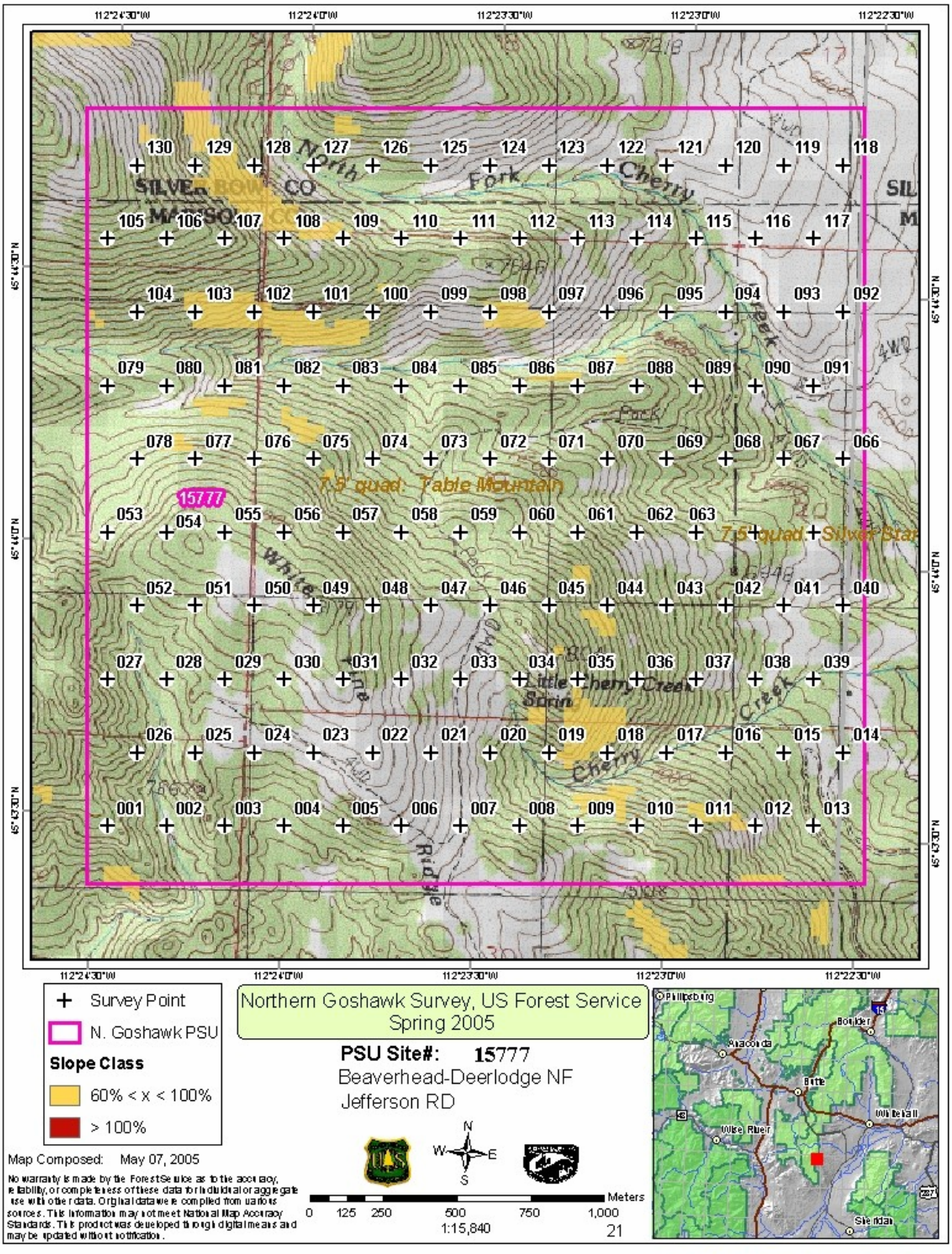
Survey Point
N. Goshawk PSU
Slope Class
60% < x < 100%
> 100%
Northern Goshawk Survey, US Forest Service
Spring 2005
PSU Site#: 15777
Beaverhead-Deerlodge NF
Jefferson RD
Map Composed: May 07, 2005
No warranty is made by the Forest Service as to the accuracy, reliability, or completeness of these data for individual or aggregate use with other data. Original data were compiled from various sources. This information may not meet National Map Accuracy Standards. This product was developed through digital means and may be updated without notification.
Meters
0 125 250 500 750 1,000
1:15,840
21
15777
7.5' quad: Table Mountain
7.5' quad: Silver Star
North Fork Cherry Creek
White Ridge
Little Cherry Creek
Cherry Creek
Phillipsburg
Boulder
Anaconda
Butte
Wise River
Whitehall
Sheridan

Figure 2